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BONAFIDE CERTIFICATE

This is to certify that the dissertation entitled

"**UMBILICAL CORD COILIND INDEX AND ITS**

RELATION TO ADVERSE PERINATAL OUTCOMES" is a bonafide record work done by **Dr. K. REVATHI** under my direct supervision and guidance, submitted to the Tamil Nadu Dr. M.G.R. Medical University in partial fulfillment of University regulation for M.D Branch II – Obstetrics & Gynaecology.

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DECLARATION

I **Dr. K. REVATHI** solemnly declare that the dissertation titled **"UMBILICAL CORD COILIND INDEX**

AND ITS RELATION TO ADVERSE PERINATAL OUTCOMES" has been prepared by me. I also declare that this bonafide work or a part of this work was not submitted by me or any other for any award, degree, diploma to any other University board either in India or abroad.

This is submitted to The Tamilnadu Dr. M. G. R. Medical University, Chennai in partial fulfillment of the rules and regulation for the award of M.D degree Branch – II (Obstetrics & Gynecology) to be held in March 2010.

Place : Madurai **Dr. K. REVATHI**

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CONTENTS

INTRODUCTION

The umbilical cord is lifeline of the fetus as it supplies water, nutrients and oxygen. Its three blood vessels pass along the length of the cord in a coiled fashion. It is vital to the development, well being and survival of the fetus, yet in no other part of the fetoplacental unit such vital blood vessels are so vulnerable to kinking, compression, traction and torsion.

This property of cord vessels was described as early as 1521 by Bergarious. In 1954, umbilical coiling was first quantified by Edmonds who divided the total number of coils by the umbilical cord length in centimeters called it “INDEX OF TWIST”. He assigned positive and negative scores to clockwise and anticlockwise coiling respectively.

John William Ballantyne (1861-1923), a British obstetrician and considered to be the father of prenatal care, said in 1904 : “A diseased fetus without its placenta and

cord is an imperfect specimen and a description of a fetal malady, unless accompanied by a notice of placental and umbilical cord condition is incomplete".

In early 1990s, Dr. Strong and his colleagues observed that children born with non coiled umbilical vessels are at increased risk for perinatal mortality and morbidity. They then developed the umbilical coiling index which is calculated by dividing the total number of complete vascular coils by the umbilical cord length in centimeters. A coil is defined as a complete 360 degrees spiral course of umbilical vessels around the Whartons Jelly.

Several studies have addressed the correlations between abnormal cord coiling and adverse pregnancy outcome. They all show an increase in adverse pregnancy outcome when there is abnormal cord coiling.

The study was undertaken to find out the umbilical coiling index in Indian babies and its relationship with antepartum and intrapartum outcomes.

AIM OF THE STUDY

1. To find out the mean umbilical coiling index in Indian babies.
2. To find out the relation between hypocoiling and hypercoiling and adverse antenatal and perinatal outcomes. The outcomes measured were gestational age, birth weight, intrauterine growth retardation, meconium staining, apgar scoring, perinatal deaths, pregnancy induced hypertension, gestational diabetes mellitus.

REVIEW OF LITERATURE

The umbilical cord is the life line of the fetus as it supplies water, nutrients and oxygen. Its three blood vessels pass along the length of the cord in a coiled fashion. It is vital to the development, wellbeing and survival of the fetus, yet in no other part of the feto placental unit such vital blood vessels are so vulnerable to kinking, compression, traction and torsion.

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John William Ballantyne (1861-1923), a British obstetrician and considered to be the father of prenatal care said in 1904 : "A diseased fetus without its placenta and cord is an imperfect specimen and a description of a fetal malady, unless accompanied by a notice of placental and umbilical cord condition is incomplete."

The average length of the umbilical cord is 50 to 60 cms. An abnormally short cord is defined as less than 30cms. Short umbilical cord may be prone to knotting, twisting and prolapse. The total number of coils for ay particular cord is believed to be established early in gestation. The pattern of coiling develops during the second and the third trimesters and changes as the pregnancy advances.

Despite the belief that umbilical vascular coiling occurs early in gestation, it is not known whether this coiling is a genetic or an acquired event. Several theories have bee proposed to explain the umbilical cord twist including those that interpret the twist as inherent to the cord itself and those that explain the twist as a result of active or passive rotation of the fetus. The hypotheses include fetal movements, active or passive torsion of the embryo, differential umbilical vascular growth rates, fetal hemodynamic forces and the arrangements of muscle fibres in the umbilical arterial wall. Regardless of its origin, the umbilical coiling appears to confer turgor to the umbilical unit, producing a cord that is strong and flexible. Therefore with a more active fetus, a more twisted umbilical cord is expected and conversely with a more sedate fetus, a poorly twisted fetus is expected. The two arteries and one vein of the umbilical cord spiral within the cord. The coiling of umbilical vessels develop as early as

28 days after conception and is present in about 95% of fetuses at 7 weeks after conception.

Complete absence of spiraling occurs in approximately 4% of cords and is associated with increased rate of chromosomal abnormalities and perinatal mortality and morbidity. The mean coiling value is 0.21 (one coiling per 5 cm of umbilical cord) hypocoiling (values less than 0.1) and hypercoiling (values greater than 0.3) have been associated with adverse perinatal outcomes. Some studies show higher UCI values have a protective effect on blood flow in terms of decreased arterial resistance and higher blood flow velocities. The coiling index can be determined by antenatal USG and may be used in antenatal risk assessment. Hypercoiled and hypocoiled ones have been associated with still birth and fetal distress in labour in comparison to normal coiling. How abnormal coiling translates into adverse fetal outcome is uncertain. In some cases, there is associated thrombosis in the placental blood vessels. Others suggest a

maturational defect in the vascular development of the villus that may lead to hypoxia of all cords. In majority of cases it is associated with normal outcome. Fetuses with single umbilical artery are likely to have growth restriction and abnormal fetal heart rate pattern in labour. One study found an overall prenatal mortality of 5% which is ten fold higher than normal.

Another mechanism that may explain why umbilical coiling is beneficial has been proposed by Reynolds. The close association between umbilical arteries and vein raise the possibility of a dynamic interaction between these vessels. The fetal blood flows through the umbilical vein, pumped by slight but definitive decreases and increases in venous pressure, caused by adjacent arterial pressure pulses. The arterial coils around the vein along the length provide multiple variations of pressure in an additive fashion, so if the number of coils increases the effect is larger. This is supported by a study by Dengani et al who found a linear

relationship between coiling and venous flow. In cases with overcoiling the effect of the arterial pressure pulses may be opposed by increased turbulence in the vessels and compression of the vein.

CORD STRUCTURE AND FUNCTION :

The umbilical cord, or funis extends from the fetal umbilicus to the fetal surface of the placenta or chorionic plate. Its exterior is dull white, moist and covered by amnion, through which the three umbilical vessels may be seen. Its diameter is 0.8 to 2.0 cm, with an average length of 55 cm and a range of 30 to 100 cm. Generally, cord length less than 30 cm is considered abnormally short. Folding and tortuosity of the vessels, frequently create nodulations on the surface or false knots which are essentially varices. The extracellular matrix is a specialized connective tissue referred to as Whartons Jelly. The two arteries are smaller in diameter than the vein. The mesoderm of the cord, which is of allantoic origin, fuses with that of the amnion.

DEVELOPMENT OF UMBILICAL CORD

By the end of the third week of development the embryo is attached to placenta via a connecting stalk. At approximately 25 days the yolk sac forms and by 28 days at the level of the anterior wall of the embryo, the yolk sac is pinched down to a vitelline duct, which is surrounded by a primitive umbilical ring.

By the end of the 5th week the primitive umbilical ring contains

1) a connecting stalk within which passes the allantois (primitive excretory duct), two umbilical arteries and one vein;
2) the vitelline duct (yolk sac stalk) ;
3) a canal which connects the intra and extra embryonic coelomic cavities.

By the 10th week the gastro intestinal tract has developed and protrudes through the umbilical ring to form a physiologically normal herniation into the umbilical cord.

Normally these loops of bowel retract by the end of the third month. Occassionally residual portions of the vitelline and allantoic ducts and their associated vessels can still be seen even in term umbilical cords, especially if the fetal end of the cord is examined.

Blood flows from the umbilical vein by two routes –the ductus venosus which empties directly into inferior vena cava and numerous small openings in the fetal hepatic circulation and then into inferior vena cava by hepatic vein. The blood takes the path of least resistance through this alternate routes resistance in the ductus venosus is controlled by a sphincter situated at the origin of ductus at the umbilical recess and innervated by the branch of vagus nerve.

Anatomically the umbilical cord can be regarded as a component of fetal membrane. The vessels contained in this cord are characterized by spiraling or twisting. The spiraling may occur in clockwise (dextral) or anticlockwise (sinistral). The sinistral spiral is present in 50 to 90% of cases. It is

believed that the spiraling serves to prevent clamping which occurs in all hollow cylinders subjected to torsion. Boyd and Hamilton (1970) note that these twists are not true spirals but rather they are cylindrical helicals in which a constant curvature is maintained equidistant from the central axis. Beirschke and Kaufmann (20000 reported that 11 is the average number of helies in the cord.

UMBILICAL CORD ABNORMALITIES :

The cord serves a vital function, but it is unfortunately susceptible to entanglement, compression and occlusion. Collins and Collins reported a 1 percent incidence of potentially harmful cord complications.

LENGTH :

Cord length at term has appreciable variation and extreme range from no cord (achordia) to lengths upto 300cms. Short umbilical cords may be associated with adverse perinatal outcomes such as fetal growth restriction, congenital outcomes such as fetal growth restriction,

congenital malformations, intrapartum distress and a two fold risk of death. (Krakowiak and associates, 2004). Excessively long cords are more likely to cause complications such as prolapse. In a study of more than 20,000 placentas, Baergen and colleagues (2001) reported a mean length of 37 cms. They defined excessively long cords to be more than two standard deviations, which was 70cm or longer. In a retrospective analysis, they compared 926 fetuses with long cords with 20 controls who had normal length cords. Pregnancies involving a fetus with a long cord were associated with maternal systemic disease and delivery complications.There were more cases of cord entanglements, fetal distress, fetal anomalies and respiratory distress. Perinatal mortality was increased nearly three fold albeit with borderline statistical significance.

Determinants of cord length intriguing. Animal studies and observational studies in human pregnancy support the concept that cord length is influenced positively by both the

volume of Amniotic fluid and fetal mobility. Hereditary is a factor and 9% women with an excessively long cord in the study by Baergen and colleagues (2001) had such finding in a subsequent pregnancy. Miller and his associates (1981) identified the cord to be shortened appreciably when there had been either chronic fetal constrained from oligohydramnios or decreased fetal movement, such as with Downs syndrome or limb dysfunction.

CORD COILING :

In most cases the umbilical vessels coarse through the cord in a spiraled manner. Several authors have observed a significant in various outcomes in fetuses with hypocoiled cords. Some of these are meconium staining, preterm birth and fetal distress (Strong and colleagues, 1993). Shen Schwarz and associates (1996) report an association between "absent" cord twisting and velamentous cord insertion. Rana and associates (1995) found a higher incidence of preterm

delivery and cocaine abuse in women with hypercoiled cords.

SINGLE UMBILICAL ARTERY

Identification of a two vessel cord is an important observation. About one fourth of all infants with only one umbilical artery have associated congenital anomalies. In a review of nearly 3,50,000 deliveries. Heifetz (1984) found an incidence of a single artery to be 0.63% in live borns, 1.92% in neonates with perinatal death and 35 in twins. The incidence is increased considerably in women with diabetes, epilepsy, preeclampsia, anterpartum hemorrhage, oligohydramnios, and hydramnios (Leung and Robson 1989). Two vessel cords were in 1.5% of 879 fetuses aborted spontaneously (Byrne and Black 1985). Over half of these had serious malformations most associated with chromosomal abnormalities.

In many cases, a single umbilical artery is detected by routine ultrasound screening. Hill and his co-workers (2001)

reported that the number of cord vessels could be quantified ultrasonically in 98 percent of cases studied between seven and thirty six weeks. The fetal pregnancies depends on whether the two vessel cord is associated other abnormalities or whether it is an isolated finding. Coexistent fetal anomalies detected by ultrasound have been reported to be from 10 and 50%. Perinatal prognosis is beterb when two vessel umbilical is an isolated sonographic findings. In one study, in Parilla and colleagues reported no adverse outcomes in 50 such fetuses. In another report Budorick and co-workers (2001) found no abnormal karyotypes and only one echocardiographic abnormality in 31 fetuses with a two vessel cord as an isolated finding. Gossett and associates (2002) reported that 74 such fetuses all had normal echocardiography. Conversely Catanzarite (1995) described 46 fetuses with this isolated ultrasonographic finding, two of whom had lethal chromosomal abnormalities and a third, a tracheo oesophageal fistula. When a two vessel cord is a non

isolated finding, as many as half of fetuses are aneuploid (Budorick and associates 2001). There are a number of associated anomalies and Pavlopoulos and colleagues (1998) reported renal aplasia, limb reduction defects and atresia of hollow organs in such fetuses suggesting a vascular etiology.

Goldkrand and colleagues (1999) performed Doppler velocimetry in 45 fetuses with a two vessel cord and 124 normal controls. Although velocity indices were all in the normal range beginning at 26 weeks, they were lower in affected fetuses than in those fetuses with normal cords. These investigators later measured blood flow and found that the single artery had volumetric blood flow equal to a normal cord with two arteries (Goldkrand and associates 2001). They concluded that growth restriction did not occur in anatomically normal fetuses with a single artery. Raio and colleagues (1999) reported an association between a single artery and a reduction of Whartons Jelly…

Velamentous insertion of the cord is a condition where cord is inserted into the fetal membranes and not into the placenta. These vessels lie unprotected within the membrane for variable distances until they reach the fetal surface of the placenta. In singleton pregnancies, the frequency is about 1% and as high as 28% in triplets. Velamentous insertions are associated with small for gestational infants. Although rare, about 2% of infants with velamentous insertion may have hemorrhage from tearing of blood vessels.

When the velamentous insertion lie over the internal os of the cervix, the condition is called vasa previa. The condition can sometimes be identified antenatally by ultrasound. When these vessels tear and bleed, they can cause rapid fetal exsanguinations. The mortality rate for a bleeding vasa previa is estimated to be 60 to 70%.

The true knot in the umbilical cord ranges in incidence from 0.04% to 1.22%. It has been estimated that the perinatal mortality rate from this condition is 8 to 11%. To

be plausible as a cause of fetal death, the knot should have edema, congestion or thrombosis.

Rupture of the umbilical cord may be partial or complete is rare and is found most often in precipitous deliveries. Short cords, trauma or inflammation are precipitating factors.

Torsion of the umbilical cord can be obstruct the blood vessels and cause fetal death. This is a rare occurrence. The presence of torsion, edema, congestion, thrombosis in the twisted cord indicates that the torsion occurred prior to fetal death.

Nuchal cord is seen in 25% of all deliveries. It is associated with respiratory acidosis and low APGAR scores in the newborn. It can be particularly hazardous in shoulder dystocia when there is prolonged delay between the head and shoulders.

Infections :

Infections can be identified in the umbilical cord. When the umbilical cord is inflamed, it is called funisitis. Microscopically the cord is infiltrated with neutrophils. Usually occurs in conjunction with chorioamnionitis in cases of PROM. About one third of placentas from preterm delivery demonstrate histological evidence of chorioamnionitis and funisitis. The fetus has to be alive for funistis to occur. Thus when funisitis is noted in still birth, infection occurred before fetal death.

Specific bacteria that are found in funisitis are group B streptococcus, E-coli, Ureaplasma urealyticum, Syphillus, Listeria monocytogenes and Treponema pallidum. Viruses causing funisitis are Cytomegalovirus and Parvovirus B 19 infections.

MATERIALS AND METHODS

The study was conducted at the Department of Obstetrics and gynaecology, Madurai Medical College, a tertiary referral centre in Tamilnadu. The proforma was submitted to the ethical committee of our hospital. The committee concluded that the present study was exempt.

During the study period from July 2008 to July 2009 placentas and umbilical cords of 500 new born babies were observed by one person who was blinded to the patient characters and the pregnancy outcomes. All specimens were unfixed. The length of the cord was measured using a non stretchable inch tape.

The umbilical cord was measured in its entirely, including the length of the placental end of the cord and the umbilical stump on the baby. The number of complete helices of the umbilical vessels were counted from the neonatal end towards the placental end. A coil was defined

as a complete 360 degree spiral course of the umbilical vessels around the Wharton's Jelly.

As introduced by **Strong et al**

$$\textbf{Umbilical Coiling Index} = \frac{\textbf{Number of coils}}{\textbf{Cord length in cms}}$$

The direction of cord coiling (sinistral, dextral) was also reported. The coiling pattern was also described as being sinistral if the course of the umbilical helix was from right to left, anti clockwise. As in previous studies, the umbilical cord coiling index was classified as hypocoiled if the cord coiling index was smaller than the 10^{th} percentile, normocoiled if the umbilical cord coiling index was between 10^{th} and 90^{th} percentile or hypercoiled if the umbilical cord coiling index was above the 90^{th} percentile.

The following data was collected :

Maternal age, gestational age at delivery, parity, socioeconomic status, obstetric history, mode of delivery, instrumental deliveries or LSCS for fetal distress, sex and

birth weight of the neonate, preterm delivery, APGAR scores, meconium staining of amniotic fluid, preeclampsia, anemia, gestational diabetes mellitus and congenital birth defects. The condition of the neonate was followed till the second postnatal day.

The placenta and umbilical cord were examined for the umbilical cord length, number of umbilical coils, insertion of the cord and for the presence of two umbilical arteries and one umbilical vein. Microscopic examination of the placenta of the placenta for signs of chorioamnionitis funisitis, chronic hypoxia was not done.

Statistical Tools :

The information collected regarding all the selected cases were recorded in a Master chart. Data analysis was done with the help of computer using Epidemiological information package (2008).

Using this software frequencies, percentage, mean, standard deviation, and ‘p’ values are calculated. Kruskul Wallis chi square test was used to test the significance of difference between quantitive variables and Yate’s test for qualitative variables. A ‘p’ values less than 0.05 is taken to denote significant relationship.

RESULTS

Table -1

Sex Distribution of umbilical cord coiling index
in newborn babies

Sex	No.of babies	Mean UCI ± SD
Male	266	0.180 ± 0.116
Female	234	0.185 ± 0.117
'p' = 0.065 (Not significant)		

In our study, there is no statistical significant difference between mean umbilical coiling index and gender.

Table – 2

Parity

Parity	No.of babies	Mean UCI $\pm$ SD
Primi	214	0.181 $\pm$ 0.126
Multi	286	0.184 $\pm$ 0.109
'p' = 0.06 (Not significant)		

In our study, there is no statistical significant difference between mean umbilical coiling index and parity.

Table – 3

Umbilical Coiling Index

Coiling Pattern	No.of babies	Mean UCI $\pm$ SD
Hyper coil	60 (12%)	0.396 $\pm$ 0.121
Normo coil	305 (61%)	0.170 $\pm$ 0.007
Hypo coil	135 (27%)	0.055 $\pm$ 0.02
'p' < 0.01 (Significant)		

In our study, Out of 500 new born babies total of 12% of hypercoil and 27% of hypocoil babies were obtained.

Table – 4

Umbilical Coiling Index with perinatal risk factors

A - Gestational Diabetes Mellitus

GDM	No.of babies	Mean UCI ± SD
Present	13	0.133 ± 0.08
Absent	487	0.184 ± 0.01
'p' = 0.06 (not significant)		

In our study, there is no statistical significant difference between mean umbilical coil index and mothers with Gestational diabetes mellitus.

Table – 5

Umbilical Coiling Index with perinatal risk factors

B - Anemia

Anemia	No.of babies	Mean UCI $\pm$ SD
Present	44	0.128 $\pm$ 0.09
Absent	456	0.187 $\pm$ 0.01
‘p’ < 0.01 (Significant)		

In our study, there is statistical significant difference between mean umbilical coil index and mothers with Anemia. ($p< 0.01$).

Table – 6

Umbilical Coiling Index with perinatal risk factors

C - Pregnancy induced hypertension

PIH	No.of babies	Mean UCI $\pm$ SD
Present	43	0.187 $\pm$ 0.118
Absent	457	0.107 $\pm$ 0.09
'p' < 0.05 (Significant)		

In our study, there is statistical significant difference between mean umbilical coil index and mothers with pregnancy induced hypertension. ($p<0.05$).

Table – 7

Umbilical Coiling Index and Neonatal and Perinatal Outcome

A - NICU Admission babies

NICU admission	No.of babies	Percentage
Hypercoil	4	4.1
Normo coil	20	20.4
Hypo coil	74	75.5
‘p’ < 0.001 (Highly significant)		

In our study, there is statistically highly significant positive relation between mean umbilical coil index and NICU admission babies ($p<0.001$).

Table – 8

B - Expired babies

Expired Babies	No.of babies	Percentage
Hypercoil	0	0
Normo coil	10	45.4
Hypo coil	12	54.5
‘p’ = 0.01 (Significant)		

In our study, there is statistical significant positive relation between mean umbilical coil index and expired babies (p=0.01).

Table – 9

C - Anomalous babies

Anomalous babies	No.of babies	Percentage
Hypercoil	0	0
Normo coil	3	50
Hypo coil	3	50
‘p’ > 0.07 (Not significant)		

In our study, there is no statistical significant relation between mean umbilical coil index and anomalous babies. P>0.07.

Table – 10

IUGR Babies

IUGR babies	No.of babies	Percentage
Hypercoil	7	11.6
Normo coil	24	40
Hypo coil	29	48.4
‘p’ < 0.001 (Significant)		

In our study, there is statistical significant positive relation between mean umbilical coil index and IUGR babies ($p<0.001$).

Table – 11

Meconium stained babies

Meconium stained babies	No.of babies	Percentage
Hypercoil	3	11.6
Normo coil	9	34.6
Hypo coil	14	53.8
‘p’ < 0.001 (Significant)		

In our study, there is statistical significant positive relation between mean umbilical coil index and meconium stained babies ($p<0.001$).

DISCUSSION

The umbilical cord and its vital blood vessels are the most vulnerable part of the fetal anatomy. The total number of coils for any particular cord is believed to be established early in the gestation. The pattern of coiling develops during the second and third trimesters, presumably due to scarls in the cord and this coiling changes as the pregnancy advances. Despite the belief that umbilical vascular coiling occurs early in gestation it is not yet known whether this coiling is a genetic or acquired event.

Several theories have been proposed to explain the umbilical cord twist including those that intercept the twist as inherent to the cord itself, and those that explain the twist as a result of active or passive rotation of the fetus. Regardless of its origin, umbilical coiling appear to confer turgor to the umbilical unit, producing a cord that is strong flexible.

Measuring the umbilical cord coiling index is not always easy, especially in cords with a very irregular coiling pattern and especially when blood has been drained from the cord. It seemed to be predominantly due to disagreement on cases with an umbilical coiling index just under or above the 10^{th} percentile.

In consideration of the hypo versus normal coiling distribution in our study, we observed that 10^{th} and 90^{th} percentiles for UCI were in agreement with the previous studies.

MEAN UMBILICAL COILING INDEX

The mean umbilical coiling index in our study was 0.183 ± 0.116 as compared to 0.20 ± 0.1 by Ereal et al 0.13 ± 0.08 by Shalu Gupta et al, 0.21 ± 0.07 by Strong et al and 0.19 ± 0.1 by Rana et al.

In our study, the mean umbilical coiling index in male babies is 0.180 ± 0.116 and in female babies is 0.185 ± 0.117 which is almost similar.

We are not able to ascertain as to why out mean UCI was lower than that of other workers. Three studies have calculated. UCI antenatal USG measurements. However a difference in antenatal UCI and UCI at birth have been reported. This could be explained by a sonographic error in the sampling of different umbilical cord segments, and inter individual variations in the measurement of cord length postnatally. We studied on unclamped cords. If the cord is clamped at both sides, the umbilical coiling index is slightly overestimated as compared with umbilical coiling index in same, unclamped cord.

COILING DENSITY :

It has been seen that coiling density is not similar in all segments of umbilical cord. Increased coiling was found at the fetal and compared with the placental and middle segments.

DIRECTION OF COILING :

The direction of UCI is predominantly found anticlockwise by all the workers. The mean of anticlockwise coils was 5.936 and clockwise coils was 3.926 and the direction of anticlockwise and clockwise umbilical coiling in our study was in the ratio 6.6 : 1. However Lacro et al showed a ratio of 8:1 between anticlockwise and clockwise coiling. We also found significant difference in the mean UCI between anticlockwise and clockwise coiling. The reason for this finding remains unexplained.

The predominance of anticlockwise twists is the result of more forceful paddling with the right arm of a fetus who has already established or the cord twist is the result of either active or passive rotation of the fetus.

NO COILING :

The incidence of cords without any coil was 6% which in our study, which is in agreement with finding of Lacro et al (5%) and Rana et al (4.9%). The lowest number of coil

was zero and highest number is 20 in a cord length of 71 cms.

SEX OF THE BABY :

In reference to sex of the baby, the average length of the umbilical cord was the same in male and female babies, ie. 54.06cms in male and 54.39 cms in females babies.

CORD LENGTH :

The average length of the umbilical cord in our study was 54.21 $\pm$ 0.42. The shortest cord measured was 32cms and the longest cord measured was 78cms.

PARITY :

The mean umbilical coiling index in primi was 0.181 $\pm$ 0.12 and in multi was 0.184 $\pm$ 0.10. There was no statistical difference in the values of UCI between primi and multi gravida mothers.

UMBILICAL COILING INDEX :

In our study out of 500 new born babies total of 12% of hypercoiled and 27% of hypocoiled babies were obtained.

The mean umbilical coiling index in hypocoiled babies is 0.055±0.02 and 0.396±0.121 in hypercoiled babies. The mean coiling index was 0.18 coils/cm in sinistrally coiled cords and 0.14 coils/cm in dextrally coiled cords.

UMBILICAL COILING INDEX WITH PERINATAL RISKFACTORS

A- GESTATIONAL DIABETES MELLITUS :

In our study, the mean umbilical coiling index born to mother with gestational diabetes mellitus was 0.133 ± 0.08 and there is no statistical significant difference in mean umbilical coiling index and mother with gestational diabetes mellitus as observed by our present study.

B - ANEMIA :

In our study, the mean umbilical coiling index born to mother with ANEMIA was 0.128 ± 0.09 and there is a statistical significant difference in mean umbilical coiling index and mother with anemia with a significant value of $p < 0.01$ as observed by our present study.

C – PREGNANCY INDUCED HYPERTENSION :

In our study, the mean umbilical coiling index born to mother with pregnancy induced hypertension was 0.187 $\pm$ 0.118 and there is a statistical significant difference in mean umbilical coiling index and mother with pregnancy induced hypertension with a significant value of $p < 0.05$ as observed by our present study.

UMBILICAL COILING INDEX AND NEONATAL AND PERINATAL OUTCOMES

A - NICU ADMISSION BABIES

In our study, out of 500 newborn babies, 98 babies were admitted in NICU. Out of 98 babies, 75.5% of babies showed hypocoiled cords and 4.1% of babies showed hyper coiled cords and there is highly statistical significant positive relation between mean umbilical coil index and NICU admission babies with a significant value of $p < 0.001$.

B - EXPIRED BABIES :

In our study, out of 500 newborn babies, 22 babies were expired. Out of 22 babies, 12 (54.5%) of babies showed hypocoiled cords and 10 (45.4%) of babies showed normo coiled cords and no babies showed hyper coiled cords. There is statistical significant positive relation between mean umbilical coil index and expired babies with a significant value of $p = 0.01$.

C - ANOMALOUS BABIES :

In our study, out of 500 newborn babies, 6 babies showed anomalies like encephalocele. Out of 6 babies, 3 (50%) babies showed hypocoiled cords and 3 (50%) babies showed normo coiled cords and no babies showed hypercoiled cords. There is no statistical significant between mean umbilical coil index and anamolous babies with a value of $p > 0.07$.

D - IUGR BABIES :

In our study, out of 500 newborn babies, 60 babies were IUGR babies. Out of 60 babies, 29 (48.4%) of babies showed hypocoiled cords and 24 (40%) of babies showed normo coiled cords and 7 (11.6%) babies showed hyper coiled cords. There is statistical significant positive relation between mean umbilical coiling index and IUGR babies with a significant value of $p < 0.001$.

E - MECONIUM STAINED BABIES :

In our study, out of 500 newborn babies, 26 babies were meconium stained babies. Out of 26 babies, 14 (53.8%) of babies showed hypocoiled cords and 9 (34.6%) of babies showed normo coiled cords and 3 (11.6%) babies showed hyper coiled cords. There is statistical significant positive relation between mean umbilical coiling index and meconium stained babies with a significant value of $p < 0.001$.

Our study highlights that lower UCI in new borns is associated with PIH in mother, meconium staining and anemia. The vessels of the cord like all hollow cylinders are prone to torsion, compression, tension and subsequent interruption of the blood flow. The risk is minimized by their helical disposition. The coiled umbilical cord, perhaps because of its elastic properties, is able to resist external forces that might compromise the umbilical vascular flow. The coiled umbilical cord acts like a semierectile organ that is more resistant to snarling torsion, stretch and compression than noncoiled one. This is referred to as ‘spontaneous internal ballottement’ and likened to the action of a concertina. Workers found higher incidence of operative delivery, growth retardation, oligohydramnios, operative delivery and meconium staining fetal heart rate disturbances and low cord pH among fetuses with hypocoiled cords. These findings are in agreement with the present study.

Not withstanding these observations, the metaanalysis pointed out the fact that hypocoiling is associated with increased with increased incidence of fetal demise, intrapartum fetal heart rate decelerations, operative delivery, fetal distress, and chorio amnionitis. We did not find any significant relationship between UCI and ponderal index, birth weight, gestation, fetal sex and IUGR.

Thus while UCI can be measured easily and reliablyin the second trimester, these estimates do not accurately reflect the UCI at term. Clearly, quantitating the degree of umbilical vascular coiling cannot be significant use unless the technic can be applied to the antepartum period.

Despite all associations we found, it was intriguing to find that even with extremely hypocoiled and hypercoiled cords, some mother gave birth to a healthy infant after an uneventful pregnancy. Because both hypocoiling and

hypercoiling are associated with adverse pregnancy outcome, we recommend that determination of the umbilical coiling index be included as a routine part of placental pathologic examination. Further more, an attractive hypothesis is that antenatal detection of cord abnormalities with ultrasonography may be helpful in selecting cases in which strict fetal monitoring is warranted, antenatally as well as intrapartum.

However, more prospective studies are required to have detailed information on the role and mechanism of umbilical coiling and its impact on the newborn.

SUMMARY

- This study was conducted in the Department of Obstetrics and Gynaecology, Government Rajaji Hospital, Madurai to clinically
- To find out the mean umbilical coiling index in Indian babies and to find out the relation between hypocoiling and hypercoiling and adverse antenatal and perinatal outcomes.
- 500 new born babies, with their umbilical cord was examined
    - 12% of babies - hypercoiling cords,
    - 27% of babies – hypocoiling cords
    - 61% of babies – normal coiling cords
- Average length of umbilical cord is 54 cms
- The shortest umbilical cord length is 32 cms
- The longest umbilical cord length is 78 cms

- The lowest number of coil was 0 and the highest number of coils is 20 in a cord length of 71cms
- The mean umbilical coiling index is 0.18 coils/cm of cord
- The mean of clockwise coil is 3.9
- The mean of anti clockwise coil is 5.9
- The ratio of anticlockwise coils : clock wise coils in our study is 6.6 :1
- The mean umbilical coiling index in mother with pregnancy induced hypertension is 0.187 coil/cm of cord and statistically significant ($p<0.05$)
- The mean umbilical coiling index in mother with anemia is 0.128 coil/cm of cord and statistically significant ($p<0.01$)
- The mean umbilical coiling index in mother with gestational diabetes mellitus is 0.133 coil/cm of cord and statistically insignificant.

In NICU admitted babies

- 75.5% of babies – hypocoiling
- 20.4% of babies – normal coiling
- 4.1 % of babies – hypercoiling

In expired babies

- 54.5% of babies – hypocoiling
- 45.4% of babies – normal coiling
- No babies in hypercoiling

In Anomalous babies

- 50% of babies – hypo coiling
- 50% of babies – normal coiling
- No babies in hypercoiling

In IUGR babies

- 48.3% of babies – hypo coiling
- 40% of babies – normal coling
- 11.7% of babies – hyper coiling

In meconium staining babies

- 53.8% of babies – hypo coiling

- 34.6% of babies – normal coiling
- 11.6% of babies – hyper coiling

- There is no statistically significant positive relationship between babies of different sex and parity status of mother.
- There is statistically significant positive relationship between babies with hypocoiling cords in NICU admitted babies, expired babies, IUGR babies, meconium stained babies.
- There is statistically significant positive relationship between mothers with pregnancy induced hypertension, anemia with hypocoiling cords of newborn babies.

CONCLUSION

Low umbilical coiling index is an indicator of adverse perintal outcome. It is associated with low APGAR score, meconium staining, mothers with anemia and pregnancy induced hypertension. If the umbilical coiling index can be measured reliably in utero by ultrasound then it might be a promising prognostic marker for adverse pregnancy outcome. This deserves to be tested in further studies.

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PROFORMA

S.No.

Name :

Age :

Obstetric code : Socio Economic Class :

LMP : EDD : Gestational Age :

Date of Delivery : Time :

Mode of Delivery :

LN Outlet LMC Vacuum

Assisted Breech LSCS

Indication :

Birth weight : Kgs

LGA SGA AGA

Sex : Male Female

Number of Coils : Clock wise Anti clockwise

Total length of Umbilical Cord cms.

$$\text{UCI} = \frac{\text{Number of coils}}{\text{Cord length in cms}}$$

Normal coiled : Hypocoiled : Hypercoiled :

Anemia :

PIH : Mild Severe

Abruption : Grade :

AP Eclampsia :

No.of fits AP IP PP

HELLP :

GDM : Diet alone Insulin

Other medical disorders (if any specify) :

Liquor : Clear Meconium Blood stained

APGAR : 1 min 5 min

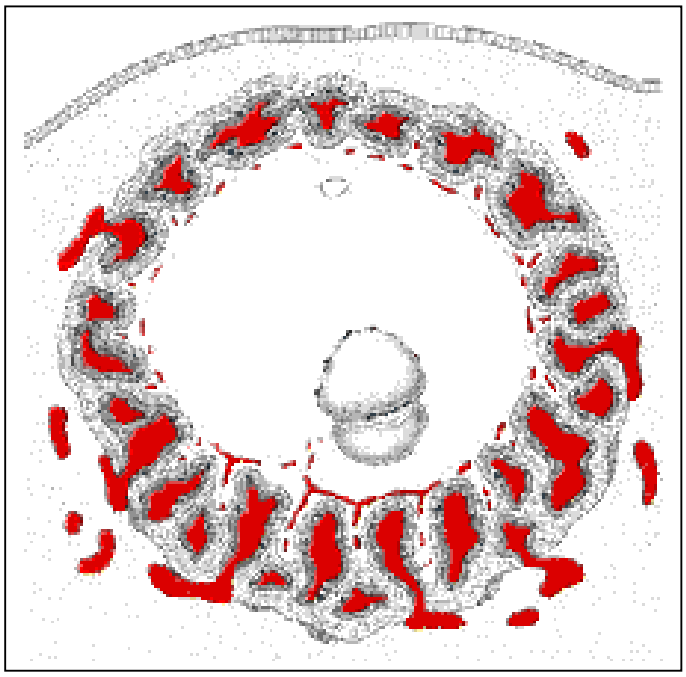
IUGR :

Baby on 2nd Post natal day :

Anomalous babies (if any specify) :

Cord : Placenta : Baby :

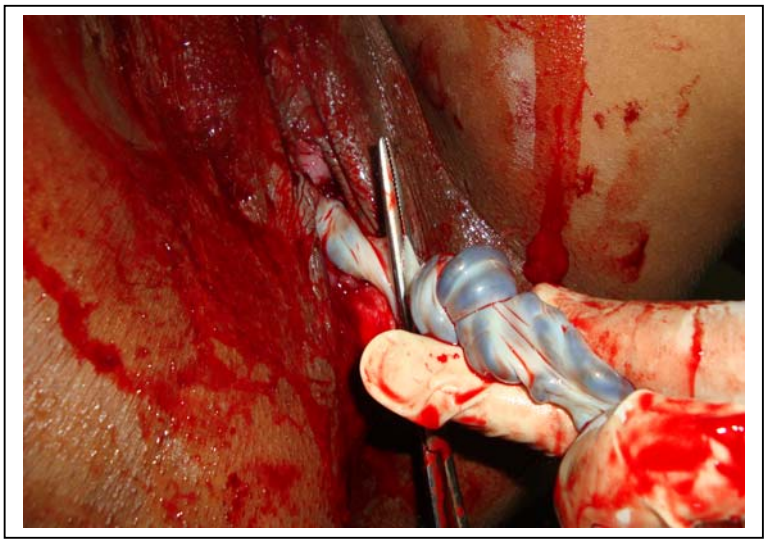
EMBRYOLOGY OF UMBILICAL CORD



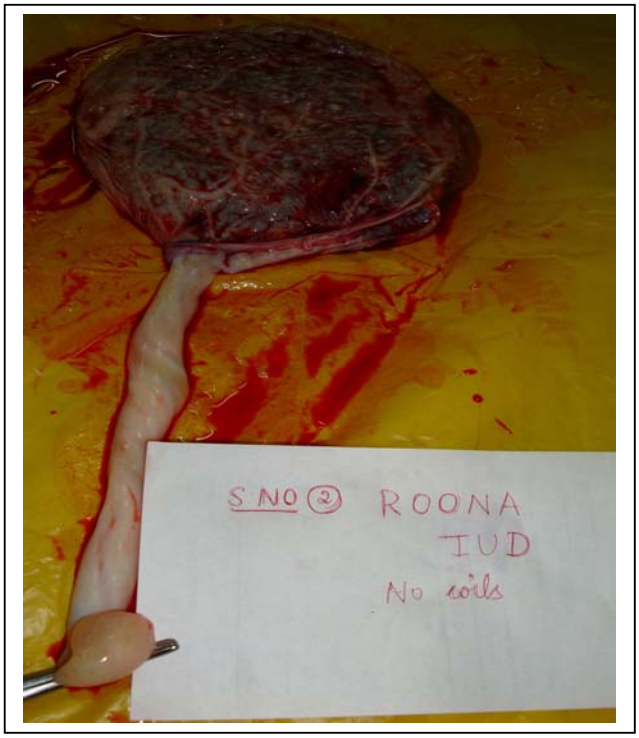
Beginning of the umbilical cord. By 21 days the embryo has begun to separate from the developing placenta by a connecting stalk. Within this stalk are the beginnings of the early circulatory system. (Modified from Sadler TW, Langman's Medical Embryology, 5th edition, Williams & Wilkins, 1985, with permission.)

NORMAL UMBILICAL CORD LENGTH

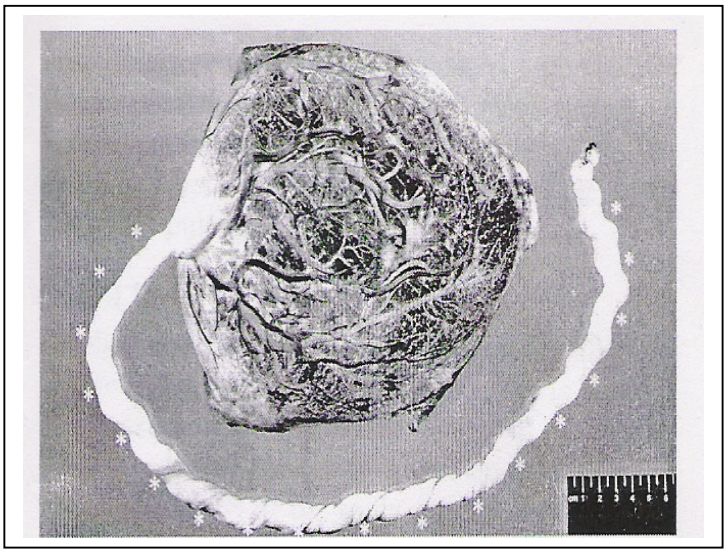
TRUE KNOT OF UMBILICAL CORD



UMBILICAL CORD WITH NO COILS



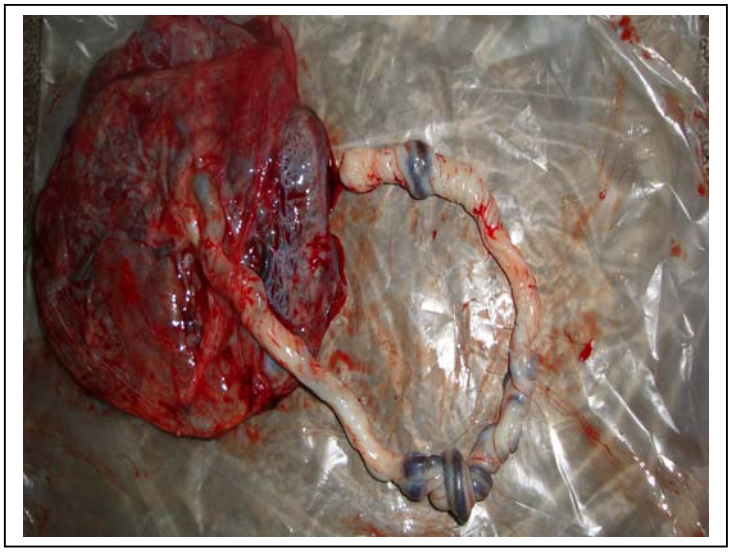
NORMO COILED UMBILICAL CORD



Coiling pattern is sinistral ; coils are marked with asterisks

de laat. Umbilical Coiling Index. Obstet Gynecol 2006

UMBILICAL CORD WITH HYPO COILS



ABBREVIATIONS

B.WT	Birth weight
Ges.age	Gestational Age
CW	Clock wise
ACW	Anti clock wise
NC	No coil
UCL	Umbilical Coiling Length
UCI	Umbilical Coiling Index
PIH	Pregnancy Induced Hypertesion
AP	Antepartum
GDM	Gestational Diabetes Mellitus
Oligo	Oligo Hydraminos
Poly	Poly Hydrominos
SD	Seizure Disorder
HD	Heart Disease
EPI	Epilepsy
Mec	Meconium stain
ASTH	Asthma
TB	Tuberculosis
Exp	Expired
ANEN	Anencephaly
Occ.enc	Occipital encephalocele
AGA	Appropriate for Gestational Age
SGA	Small for gestational age
LGA	Large for gestational age

UMBILICAL CORD COILING INDEX AND ITS RELATION TO ADVERSE PERINATAL OUTCOMES

DISSERTATION SUBMITTED FOR

M.D (BRANCH – II)

(OBSTETRICS & GYNAECOLOGY)

MARCH 2010

THE TAMILNADU

DR.M.G.R. MEDICAL UNIVERSITY

CHENNAI, TAMILNADU

BONAFIDE CERTIFICATE

This is to certify that the dissertation entitled "**UMBILICAL CORD COILIND INDEX AND ITS RELATION TO ADVERSE PERINATAL OUTCOMES"** is a bonafide record work done by **Dr. K. REVATHI** under my direct supervision and guidance, submitted to the Tamil Nadu Dr. M.G.R. Medical University in partial fulfillment of University regulation for M.D Branch II – Obstetrics & Gynaecology.

Dr. DILSHATH. M.D.,D.G.O.,
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DECLARATION

I **Dr. K. REVATHI** solemnly declare that the dissertation titled **"UMBILICAL CORD COILIND INDEX AND ITS RELATION TO ADVERSE PERINATAL OUTCOMES"** has been prepared by me. I also declare that this bonafide work or a part of this work was not submitted by me or any other for any award, degree, diploma to any other University board either in India or abroad.

This is submitted to The Tamilnadu Dr. M. G. R. Medical University, Chennai in partial fulfillment of the rules and regulation for the award of M.D degree Branch – II (Obstetrics & Gynecology) to be held in March 2010.

Place : Madurai **Dr. K. REVATHI**

Date :

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CONTENTS